Advances in Low Volume Application of Agricultural Chemicals with Mist-Size Drops

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NEW EQUIPMENT

Several new Windfoil sprayers have been introduced in 1987-88 that can apply mist-size drops to more crops, and in more ways. This techmology has been expanded to the custom operator, the commercial lawn care industry, golf courses and city parks. A new concept of nozzle pattern monitoring with sound has given the operator the ability to know that his nozzles are putting out a good pattern without seeing it.

Autotrans for High Efficiency Spraying

An Autotrans boom for both 3/4 ton trucks, Spra Coupes and floaters was developed. Equipped with a 1600 liter (350 Imp. Gal.) tank on a 3/4 ton 4WD truck, a farmer can spray a quarter section with 20 L/ha (2 gal/ac), without refilling his tank. This removes that need for a water truck because of the time between refills and the ease of transport. The boom automatically folds behind the truck to 5 ft. wide and can be transported at highway speeds making it practical to return to his operation base for filling. Both the field and transport wheels have rubber block suspensions for better rides at higher speeds.

Suspended Boom Mature Crop Sprayer

A suspended boom was developed for mature crop application. Mounted on a high clearance trailer or 3 point hitch, it gives the applicator the ability to apply fungicides to control sclerotinia and insecticides to control wheat midge, plus other mature crop insects. It can also be used for spring applications of herbicides. The boom can be raised to spray crops up to 1 meter high. This sprayer will give the researcher and farmer inproved control of timing which may improve growth regulator efficacy in ICM cropping methods.

Spray Pattern Monitor

An electronic sensor that listens to sound that the spray sheet makes has been developed to monitor each tip's spray pattern. It can detect malfunctioning tips that have only a 2% reduction in flow. The number of the malfunctioning tip is displayed in the tractor cab and a buzzer warns the operator of the problem. It is self-calibrating and the operator can adjust the sensitivity.

500 Mesh Filters

The very small tips required to apply chemicals at low application rates require finer filters than available in the market. Standard filters have been converted to 500 mesh to reduce the plugging problems with ultra small tips. These filters fit into conventional nozzle assemblies.

Turf Applicators

The Turfoil, a 30-inch wind protected push sprayer has been developed for the commercial lawn care industry. It gives the commercial applicator the same excellent wind protection as the farmer gets from his agricultural Windfoil sprayer. This unit is built with fiber glass, with 2 wheels under the shroud and receives its spray solution from the service truck. Plus a 20 ft. truck mounted parks special Windfoil with breakaway wings and vertical lift booms to go by posts has been developed for cities and golf courses. The unit has its own hydraulics and electrical system so that all its functions can be operated from the cab of the truck.

DRIFT EVALUATIONS by DOW CHEMICAL

Dow Chemical (Milo Milhajlovich, Saskatoon) did a visual drift comparison of a Windfoil 2 meter push research sprayer and a conventional open boom research sprayer. Test runs were made 9 meters apart with 2 meter conventional and Windfoil plot sprayers in 10, 15, and 25 km/h winds. Paraquat (Sweep) was applied by both sprayers at recommended rates. Drift damage was visible 6 meters downwind from the conventional sprayer in the10 km/h wind treatment. The Windfoil showed no signs of drift. Most researchers generally consider it safe to apply chemical in 10 km/h winds and often do in 15 km/h winds. In the 15 km/h wind conventional sprayer treatment the entire crop was wiped out clear across to the next treatment, 6 m away. The drift illustrated in this test may be responsible for much of the variability in many field herbicide tests.

STATE OF ARKANSAS RECOMMENDS REDUCED RATES

The State of Arkansas, in its Weedbook, has added several new herbicides to its reduced chemical rate application recommendations. These rates are based on early application of chemical, with some consideration given to environmental effects. They make these recommendations, saying that they require a greater degree of management skills and that only knowledgeable applicators should try them. **They do recommend rates that save the operator 3/4 of his chemical costs.** Such a program is needed in Saskatchewan.

SPRAY DEPOSIT EVALUATION IN STANDING STUBBLE

This study has been contracted by the Western Canadian Wheat Growers with funds from the Western Grains Research Foundation.

Introduction

The studies that have focused on the control of weeds on stubble fields with chem fallow have demonstrated the tremendous potential to conserve moisture, reduce soil erosion and soil degradation, but chemicals applied at label rates are not cost-effective.

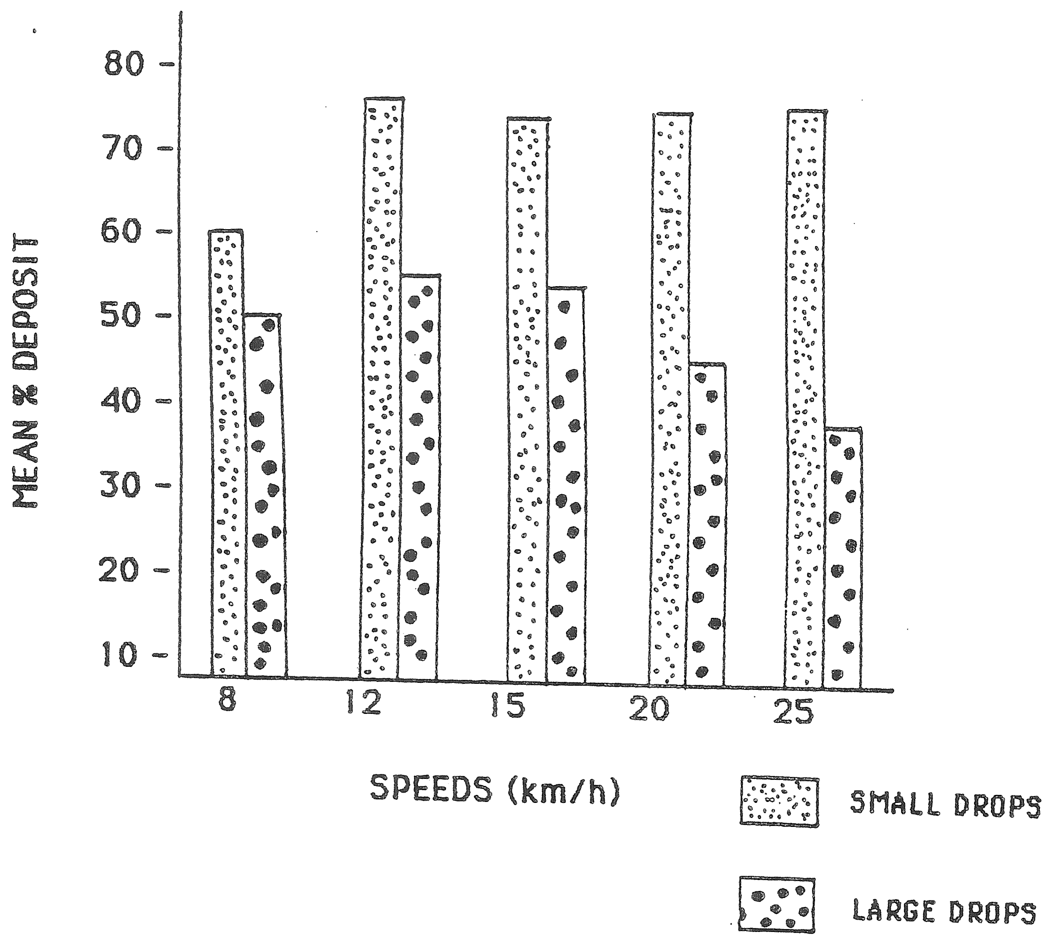
Shrouded sprayers give the applicator the ability to apply mist-size droplets that allow him to reduce carrier volumes and raise concentrations of the herbicides. The reduction in carrier volumes and the resulting higher concentrations of the herbicide increased the osmotic potential of the liquid, which generally increased the chemical uptake by the plant. Reduced rates, as low as 20% of the recommended chemical rate, have given weed control in cereal crops and in chem fallow [Rogers and Hatchard (1986), Rogers and Maki (1986), Kirkland (1986)].

On stubble fields, however, little is known about the critical factors which affect mist-size drop application. An understanding of the various factors that affect the deposition and retention of spray droplets on small plants in stubble will help to improve application techniques, and will determine the extent of shading by stubble stands if such shading occurs at all. The main objective of this study is the evaluation of the effect of drop size, nozzle angle, speed and direction of the sprayer movement in relation to stubble rows on the coverage and control of weeds in stubble.

Materials and Methods

Field experiments were conducted in the autumn of 1987. The experiment was seeded twice in the spring but extreme dry weather reduced germination to unacceptable levels. Barley was seeded between stubble rows, 6 ->8" high, and used as weeds. The tests were in two parts: coverage and weed control.

FIGURE ONE: PERCENT DEPOSIT ON PAPER TARGETS
DROPSIZE VS. SPEED
OCTOBER, 1987



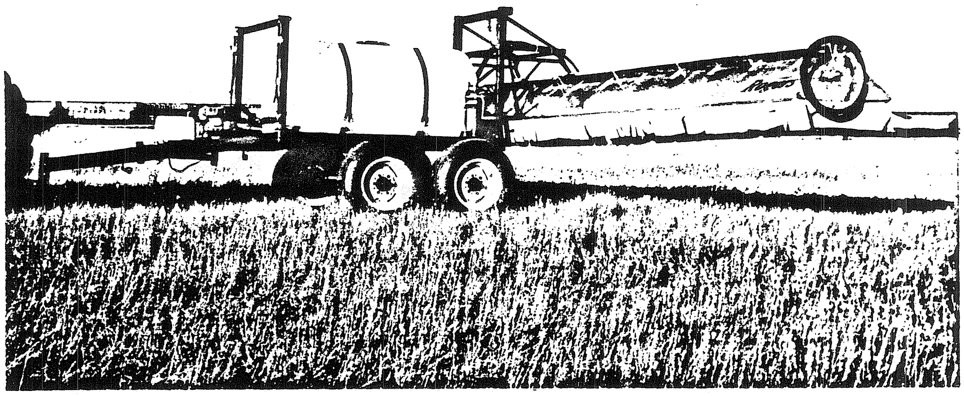


FIGURE TWO: A suspended boom Windfoil for mature crop application.

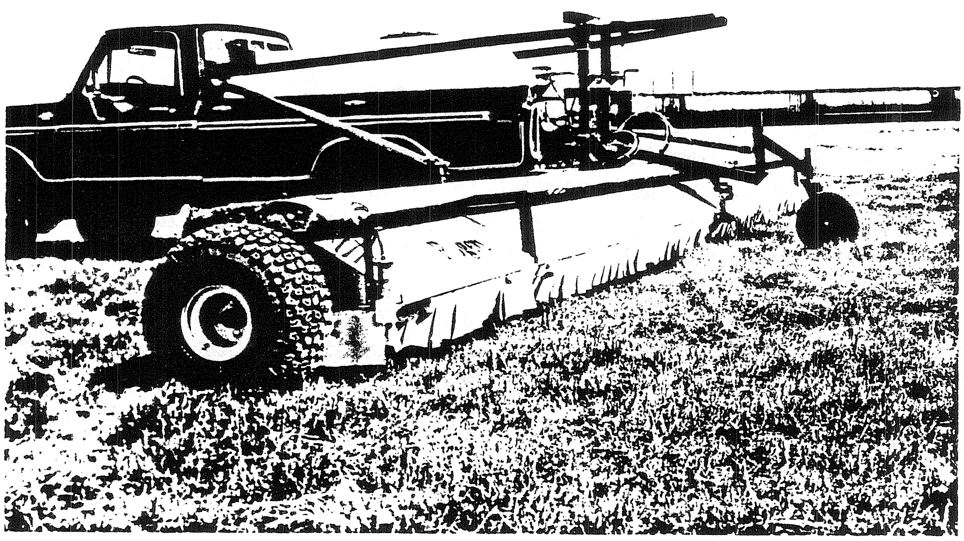


FIGURE THREE: The Autotrans Windfoil sprayer.

The coverage tests consisted of 18 treatments in which two drop sizes, three angles and five speeds were investigated. The drop sizes were conventional drops from a 80015LP, 80 mesh screen, 410 µm VMD drops, 100 L/ha [10 gal/ac] and mist-size drops from an 800017TC, 500 mesh screen, 130 µm VMD drops, 10 L/ha [1 gal/ac]) nozzle tips. The three angles were 30° ahead, vertical a 30° backwards. The speeds investigated in the coverage tests were 8 km/h, 12 km/h, 15 km/h, 20 km/h and 25 km/h.

Glyphosate at 100% of the recommended rate for tame oats was mixed with Agral 90 and sodium fluorescein dye. The mixture was applied to barley seedlings at the 2-3 leaf stage, as stated above, using a 2 meter Windfoil shrouded sprayer pulled by an all-terrain vehicle for both drop sizes. All sprayed plots had paper strips laid in the stubble to confirm the amount and eveness of the spray. Plots that had plugged tips were resprayed on extra plots left for that purpose. After the treatments were applied, the spray was allowed to dry. Eight, 1 meter long samples of the sprayed plants were cut and bagged manually (approximately 80 plants). Disposable gloves were worn to prevent cross contamination of the samples. The barley samples, paper strips and blank samples (from untreated plots) were placed in labelled bags and taken to the laboratory for analysis.

The plant samples were weighed and the fresh weights were recorded for each meter length of cut samples. To the plants and paper targets forty millimetres of wash solution was metered. Each sample was then hand-shaken for 30 seconds. The resulting solution was analysed by the fluorometer, and calculations were made to evaluate the amount of chemical deposited on either the plant or paper targets.

The control tests with glyphosate and paraquat had a total of 20 treatments. Both chemicals were tested with drop sizes of 410 µm and 130 µm at 0, 10, 20, 30 and 100% of the recommended label rates. Speed was constant at 8 km/h and two angles were used - 30° ahead and vertical. The volume of water used was 100 L/ha with the 410 µm drops and 10 L/ha with the 130 µm. Weed control was evaluated visually 7 and 14 days after treatment. The visual evaluations were based on the scale of 0-9, used by the Expert Committee on Weeds.

The effect of the direction of the sprayer was evaluated with paper targets placed on the ground. The spray was applied parallel and perpendicular to the stubble rows to determine the effect spray direction had on deposition.

Results

Mist-size drops deposited 1.9% of the solution applied on the plants whereas conventional drops only applied .4%. Mist-size drops improved deposition by 4.75 times as much of the solution applied as conventional with plant targets. With paper targets the improvement was 46% more. This difference between targets types can be attributed to the difference in collector efficiency. Bowse et al showed that these differences increased as drop size decreased. The mist sized drops are very buoyant in the air and have considerable lateral movement before they reach the ground. Air currents or turbulence can also whip them around and behind obstacles to reach small weeds.

The angle studies only gave minor differences between angles. The ahead position gave less deposit than vertical and backward facing tips. Because this is contradictory to existing research, it needs to be confirmed by more research. Speed variation gave differences on targets but not on plants. Interestingly, small drop deposit on targets did not drop as speed increased as did large drop deposit (see Fig. #1).

The deposit on target strips did not vary as spray was applied across the row or with the row.

Weed control results were poor because of the cool weather in August and September and the difference, although minor, showed that mist drops did increase control at the 5% level of significance.

Conclusions

1. Drop size was highly significant with respect to the amount of deposit on the barley plants. The small drops (130 µm VMD) had a mean percent deposit which was 4.75 times larger thar the large drops (410 µm in diameter). With the paper targets, small drops deposited 46% moı than the large drops.

2. Plants and paper targets have vastly different collection efficiencies that are emphasized as drop size is reduced.

3. The direction of travel over stubble rows of the sprayer did not significantly affect the deposit on the paper targets on the ground between stubble rows with either drop size.

4. Although deposit decreased as speed increased with the paper targets, control was not adversely affected.

RECOMMENDATIONS

1. Research is required to correlate the increase in deposit of the mist sized drops to increased control.

2. The 800017TC tips are being used at a pressure and height that the top has a co-efficient of variation (C.V.) of approximately 40. The current recommendation is to replace tips when the C.V. is above 15%. This figure needs to be justified by field plot control rather than by patternator studies.

3. An Action committee should be set up under the Expert Committee on Weeds to co-ordinate research to develop the data required to develop a Cost Effective Weed Control program similiar to Arkansas'. This committee should consider the interactions of all application variables and how they can be synergetically combined to increase the farmers benefit on his dollars invested in chemical weed control. All farmers have a right to know what affects weed control and what they can do to increase their returns from dollars invested in chemicals. The scientific community is being irresponsible by forcing them to use more chemical than necessary with out dated application technology.

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TABLE ONE: Percentage deposits on barley seedlings in stubble.

Factors		No. of Observations Averaged	Mean % Values		Levels of Significance 1%	5%
Drop Size (nozzle)	Small	36	1.9		a	a
	Large	36	0.4		b	b
				LSD	0.5	0.31
Angles	Vertical	24	1.6		a	a
	Backwards	24	1.0		ab	b
	Ahead	24	0.8		b	b
				LSD	0.69	0.38
Speeds	12 km/h	24	1.3		No Significance	
	15 km/h	24	1.1			
	8 km/h	24	1.0			
				LSD	0.6	0.38

TABLE TWO: Deposits on the paper targets in the speed tests.

Factors		No. of Observations Averaged	Mean % Values		Levels of Significance 1%	5%
Drop Size	Small	40	71.7		a	a
	Large	40	48.9		b	b
				LSD	7.1	5.3
Direction	With Stubble Row	40	61.3		No Significance	
	Against Stubble Row	40	59.3			
				LSD	7.1	5.3
Speed	12 km/h	16	66.7		a	a
	15 km/h	16	63.8		a	ab
	20 km/h	16	59.4		a	abc
	25 km/h	16	56.4		a	bc
	8 km/h	16	55.2		a	c
				LSD	11.2	8.3